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Rhithrogena sartorii, a new mayfly species (Ephemeroptera: Heptageniidae) from North Africa

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Abstract

A new species, *Rhithrogena sartorii* Zrelli & Boumaiza, **sp. nov.** is described in subimaginal, egg and nymphal stages from material collected in Northern Tunisia. This species shows affinities with members of the *insularis* species group. Features distinguishing the new species from other North African species, as well as from *Rhithrogena insularis* (from Corsica) and *Rhithrogena nuragica* (from Sardinia) are discussed.

Keys words: Mayflies, taxonomy, morphology, egg, *Rhithrogeninae*, Khroumirie, Tunisia

Introduction

Recently, the generic situation in Heptageniidae of the world has been discussed by Webb and McCafferty (2008). The genus *Rhithrogena* Eaton, 1881 belongs to the subfamily Rhithrogeninae and includes ca 150 species mostly distributed in Palearctic region (Barber-James *et al*, 2008), with a high degree of endemism in mountain areas and on islands. Larvae of the genus are easily recognized by the shape of the first pair of gills which meet or overlap ventrally to form a friction disk (Webb & McCafferty, 2008).

In North Africa, this genus is represented by 5 species: *R. ourika* Thomas & Mohati, 1985, *R. ayadi* Dakki & Thomas, 1986, *R. ryszardi* Thomas *et al*., 1987*, R. giudicelliorum* Thomas & Bouzidi, 1987 and *R. mariae* Vitte, 1991. Up to now, only *R. mariae* is known at the nymphal stage and belongs to the *semicolorata* group; *R. ryszardi* belongs to the *germanica* group and the three other species have not been assigned to any group (Sartori & Hughes, 2007).

In Tunisia, the genus *Rhithrogena* is mentioned in ecological papers (Boumaiza & Thomas, 1986), checklist on aquatics insects (Thomas, 1998) or hydrobiological contributions (Kraiem, 1986). However, no specific identification of this material has been proposed so far.

In the present study, an investigation of the streams in Northern Tunisia (Zrelli *et al,* 2011) resulted in the discovery of several *Rhithrogena* populations. After careful examination, it appeared that these populations belonged to a new species. Mature nymphs, eggs, and subimagos are described. The new species presents affinities with the *insularis* species group, i.e. *R. insularis* Esben-Petersen, 1913 from Corsica and *R. nuragica* Belfiore, 1987 from Sardinia.

Materiel and methods

The study sites are located in Khroumirie in Northern Tunisia (Fig. 1). The mayflies were preserved in ethanol (70%), some were dissected under the stereo microscope and were mounted on slides in Canadian balsam after a short stay in Creosote solution. The male and female subimagos were obtained by rearing in the laboratory. Unfortunately, no adults were obtained.

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Egg procedure for Scanning Electronic Microscope study follows Ubero-Pascal & Puig (2007). Eggs were mounted, sputter coated with gold-palladium and finally examined with JSM-6300F scanning electron microscope with working voltages of 5 KV.

The holotype and some of the paratypes are housed in the Museum of Zoology, Lausanne, Switzerland (MZL). Other paratypes are deposited in the Collection of the Laboratory of Environment Biomonitoring (LBE), Unit of Hydrobiology, Faculty of Sciences of Bizerta, Tunisia.

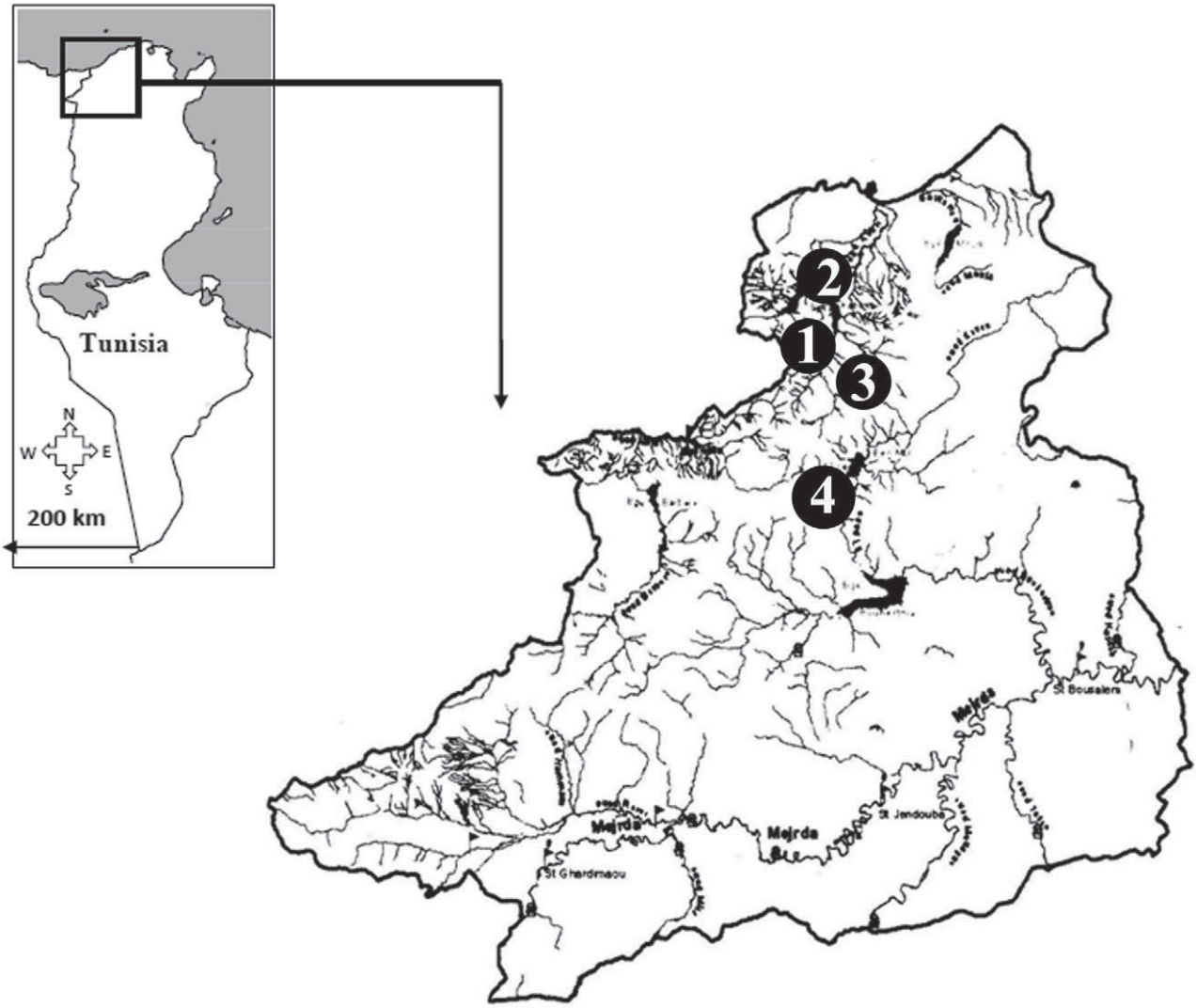


FIGURE 1. Location of the *Rithrogena sartorii* **sp. nov.** sampling sites in Northern Tunisia: 1. Ennour. 2. Rennagha. 3. Berbeg. 4. Ghezala.

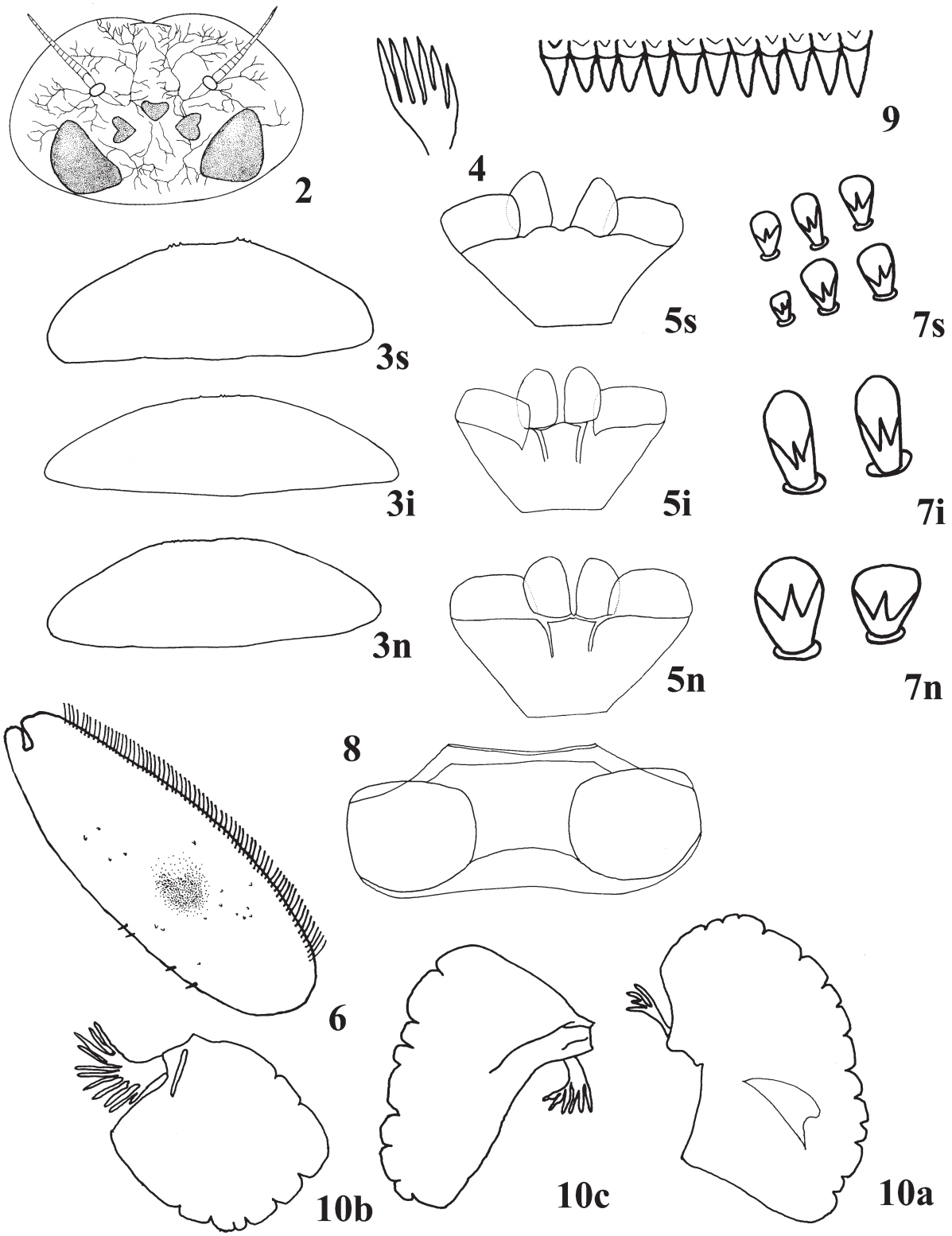
***Rithrogena sartorii* Zrelli & Boumaiza, sp. nov.**
(Figs. 2–19)

Material examined. Holotype: 1 nymph (preserved in ethanol), Ennour, 36.80072N 8.65871E 418 m., 28-IV-2010, S. Zrelli (MZL). Paratypes**:** same data as the holotype: 30 nymphs, 1 male subimago, 2 females subimagos (MZL, LBE).

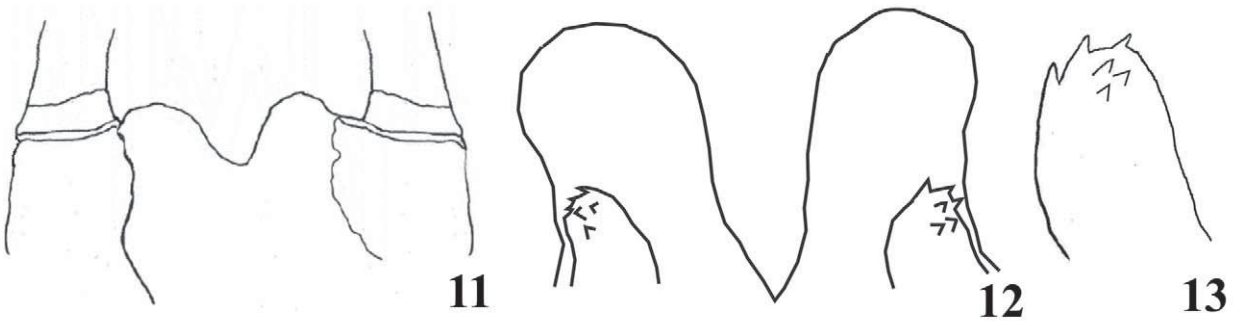
Other material examined. Same locality 24-V-2005, 1 nymph, 30-IV-2006, 1 nymph; Berbeg, 36.74968N 8.69693E, 558 m., 21-V-2005, 1 nymph; Rennagha, 36.85997N 8.72096E, 58 m. 29-VII-2005, 1 nymph; Ghezala, 36.64313N 8.69852E, 229m, 24-V-2005, 1 nymph.

Description. ***Nymph*.** Body length of final instar, excluding caudal filaments, up to 4.5 mm and 7.5 mm for male and female nymphs respectively. Cerci, 5.0–7.3 mm. Color: body brownish with visible tracheation on the whole body.

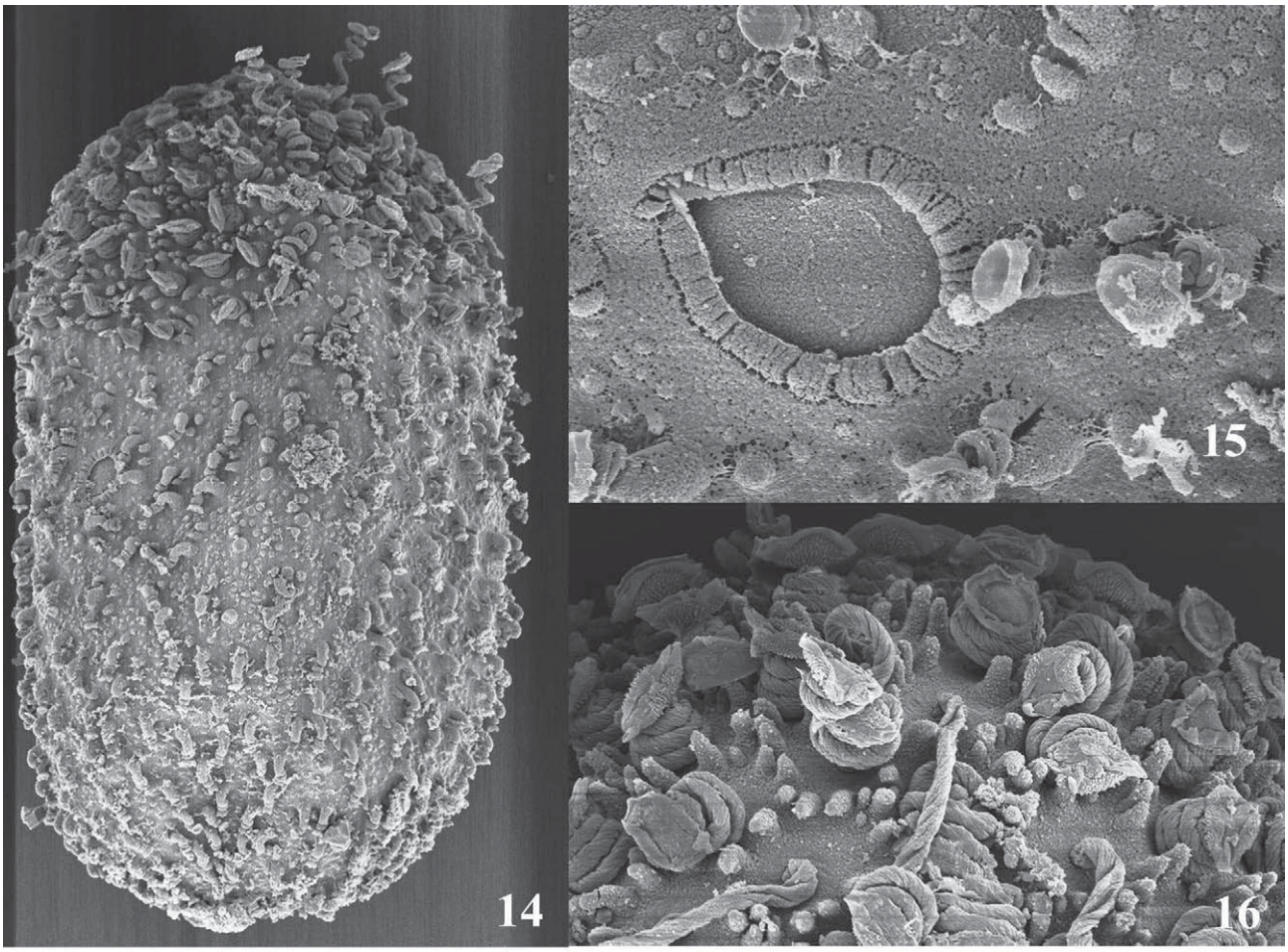
Head dark brown, subtrapezoidal with convex sides and rounded hind corners (Fig. 2). Labrum narrow, with distinct anterior teeth (Fig. 3s), 9–11 comb-shaped bristles on fore margin of maxilla with 6–7 teeth (Fig. 4). Glossae subovoidal with rounded apex (Fig. 5s).



FIGURES 2–10. *Rhithrogena sartorii* **sp. nov.**, larva: 2. Head, dorsal. 3s. Labrum, dorsal face 4. Comb-shaped setae from maxillary lacinia. 5s. Labium (dorsal view). 6. Hind femur. 7s. Bristles from the margin and the central part of hind femur. 8. First abdominal sternite. 9. Posterior margin of tergum V. 10a. Gill I. 10b. Gill II. 10c. Gill VII. *R. insularis*, 3i. 5i. 7i. *R. nuragica*, 3n. 5n. 7n.



FIGURES 11–13. *Rhithrogena sartorii* **sp. nov.**, male subimago: 11. Styliger plate and gonopods in ventral view. 12. Penis. 13. Titillator, lateral view.



FIGURES 14–16. *Rhithrogena sartorii* **sp. nov.**, egg: 14. General view. 15. Detail of the micropyle. 16. Polar cap.

Dorsal surface of femora of all legs with few spines and an ovoid dark spot well visible on the center of the median pale area (Fig. 6). Bristles on hind femora very short with diverging margins (Fig. 7s). Tarsal claws with two or three denticles. Lateral sclerites of the first abdominal sternite rectangular with their anterior margin perpendicular to the body axis (Fig. 8). Posterior margin of abdominal tergites regularly dentate in central part, with few supplementary microdenticles (Fig. 9). All gill lamellae crenulated (10a, 10b and 10c). Plica on the first gill triangular with slightly concave apex (Fig. 10a).

Male subimago. Body length 9.0 mm, forewing 8.0 mm. Cerci 9.0 mm. General color brown except the thorax, lighter. Eyes darkish brown. Sterna lighter than terga. Fore legs brown, femora with an elongated dark spot. Mid- and hind legs lighter, yellowish brown, and femora with a dark spot more elongated. Styliger plate and for-

ceps brown, posterior margin deeply incised in the middle (Fig. 11). Forceps uniformly brown, 3 segmented with a well defined basal segment, the 1st segment the longest, the 2nd and the 3rd equal in length. Genitalia as in Fig. 12. Titillators with apical margin bearing 3–4 teeth with 3 subapical teeth visible on their surface (Fig. 13).

Female subimago. Body length 7.3–8.0 mm, forewings 5.7–7.0 mm. General color yellowish brown. Thorax brown, abdomen with color pattern similar to male. All legs with elongated spots on the dorsal side of femora.

Eggs. Length: 180–200 µm, width: 150–170 µm. General shape ovoid (Fig. 14). Polar cap at one pole with numerous adhesive elements (KCTs). Micropyle with well developed margin (Fig. 15). Chorionic surface with several KCTs and with microgranules irregularly arranged (Fig. 16).

Male and female imagos unknown

Etymology. The species is named to honour Dr. Michel Sartori (Museum of zoology, Lausanne, Switzerland), who is a long-time investigator of the genus *Rhithrogena*.

Affinities. *Rhithrogena sartorii* **sp. nov.** seems to belong to the *insularis*-group which included up to now only *R. insularis* Esben-Petersen 1913 and *R. nuragica* Belfiore 1987. According to Belfiore (1987) and Belfiore *et al.* (1992) the nymphs of both species shows a unique combination of characters: 1) lateral sclerites of the first abdominal sternite with anterior margin perpendicular to the body axis; 2) all gills crenulated; 3) a dark spot on the dorsal side of femora; 4) plica on the first gill triangular; and 5) the presence of well-developed tubercules on egg chorion. First 3 characters are also shared by species of the *hybrida/hercynia* species group, but the last two clearly differ from it. In the present state of our knowledge, *R. sartorii* is morphologically close to the species of the *R. insularis* group, but genetic data based on both mitochondrial and nuclear markers are congruent and place *R. sartorii* in a cluster quite distant from them (L. Vuataz, comm. pers.).

When compared to the species found in Morroco, *R. sartorii* clearly differs from *R. mariae* and *R. ryszardi* which belong to the *semicolorata* and the *germanica* species group respectively, which gills II–VII are not crenulated. It also differs from *R. ourika, R. ayadi* and *R. giudicelliorum*, mainly by the shape of the male titillators.

The main diagnostic nymphal characters are described and compared with the two *insularis*-group species in Table 1. The nymph of the new species can be distinguished especially by the number of comb-shaped bristles and the number of teeth on the comb-shaped bristles at the tip of lacinia. The shape of the chorionic tubercles is somewhat intermediate between those of *R. insularis* and *R. nuragica*. KCTs lack the finger-like processes found in *R. insularis*, and the arrangement of the KCTs is less regular than in *R. nuragica* (Belfiore, 1987).

TABLE 1. Some descriptive characters of *Rhithrogena sartorii* **sp. nov.** compared with two related species: *R. nuragica* and *R. insularis*.

Character	*Rhithrogena sartorii* **sp. nov.**	*Rhithrogena nuragica* Belfiore 1987	*Rhithrogena insularis* Esben-Peterson 1913
Mean body length (mm)	6	7,5	6,8
Plica on the first gill	Triangular with slightly concave apex	Subtriangular	Subtriangular
Form of the second gill	Rectangular	Rhomboïdal	Rhomboïdal
Glossae	Subovoidal	Subtriangular and narrow	Subovoidal and wide
Emargination of the Labrum	Smooth	pronounced	smooth
Number of comb-shaped setae on the maxilla	9–11	8–9	7–8
Number of teeth on comb-shaped setae of the maxilla	6–7	9–10	9–11
Dark spot of the femora	Well visible	Hardly visible	Visible
Length of bristles on dorsal side of hind femora	Very short	Short	Long
Shape of setae on dorsal side of hind femora	Divergent	Divergent	Narrow

Ecology. Nymphs of the new species were collected in four different sites in strong current of streams and riffles of rivers with cobble substrates. Streams ranged in width from 4 m (Berbeg) to 10 m (Ennour), and water depth

not exceeding 65 cm at all collecting sites. The very low mineralization of water (<0.15 PSU) can explain the absence of the new species in the other streams of Northern Tunisia which are more mineralized.

Acknowledgments

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